

بسم الله الرحمن الرحيم

**SUDAN UNIVERSITY OF SCIENCE AND  
TECHNOLOGY**  
**COLLEGE OF GRADUATE STUDIES**  
**MECHANICAL ENGINEERING DEPARTMENT**

**Proportions of an axial  
Wind Turbine to be used  
in North of Sudan**

*Thesis submitted in partial  
fulfillment to the college of  
engineering for the requirement of*

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### **Abstract**

**This study has been carried out to exploit the wind energy to lift water from deep well for domestic use in the north of Sudan where the wind is available.**

**The result of this study gave the estimation of proportions of five blades with tubes on the concave sides with supporting horizontal axis against the wind to achieve the task.**

### **الخلاصة**

تم اعداد هذه الدراسة لاستغلال طاقة الرياح لرفع مياه جوفية للاستخدامات المنزليه فى شمال السودان حيث الرياح متوفره

هذة الدراسه خلصت الى حساب ابعاد تربیزه هوانیه تتكون  
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# Contents

i	abstract	ii
ii	Acknowledgments	iii
iii	Contents	iv
iv	<b>Symbols</b>	vii
<b>1</b>	<b>Chapter One:- Introduction</b>	1
<b>2</b>	<b>Chapter Two:-Theoretical Approach</b>	4
<b>2.1.</b>	<b>Energy from wind</b>	5
2.1.2	Dynamic Pressure and Dynamic Force exerted by wind	5
2.1.3	Distribution of pressure round a surface	6
2.1.4	Lift and Drag forces	7
2.1.5	Angle of incidence	8
2.1.6	Case of moving bodies	9
2.1.7	Extraction of energy from wind	9
2.1.8	Distribution of pressure	10
2.1.9	Thrust on rotor	10
2.1.10	Axial induction factor	11
2.1.11	Power extracted by the rotor	12
2.1.12	Effect of resisting torque and tangential induction factor	13
2.1.13	Driving force	14
2.1.14	Power ,torque and speed selection	15
<b>2.2</b>	<b>Rotor calculation</b>	19
2.2.1	Blade radius	20
2.2.2	Tip speed ratio	21
2.2.3	The type of blade	22
2.2.4	Torque produced	23
<b>2.3</b>	<b>geometric and dynamic similarity</b>	24
<b>2.4</b>	<b>Forces and stresses on the rotor</b>	26
2.4.1	Rotor Stresses	26
2.4.2	Forces and moments on the rotor	26
2.4.3	Stresses in the rotor spoke at the hub	30
2.4.4	Stresses in the tube which support the blade	31
<b>2.5.</b>	<b>Tower</b>	34
2.5.1	Forces on the tower	34

2.5.2	Effects of the above forces on the vertical legs and Blocks of the Tower	38
2.5.3	Stresses in the tower vertical legs	39
2.5.3.1	Stresses due to compression forces	39
2.5.3.2	Stresses due to the tensile forces	40
2.5.4	Foundation blocks	40
2.5.4.1	Foundation weight	40
2.5.4.2	Bearing pressure	41
<b>3</b>	<b>Chapter Three: Estimation of the Wind Turbine load</b>	<b>43</b>
<b>3.1.1</b>	Pump loads	44
3.1.2	Pump size	45
<b>3.1.3</b>	Inertia head	47
3.1.4	Indicator diagram	48
3.1.5	Air vessel	49
3.2	Pump proportions	50
3.2.1	Two alternative arrangements are possible	51
<b>4</b>	<b>Chapter Four: Rotor proportions</b>	<b>53</b>
4.1	Rotor blade	54
4.2	Selection of tip speed ratio	54
4.3	Angular speed of the rotor	54
4.4	Selection of the type of blade	54
4.5	Chord width calculation	55
4.6	Span length	57
4.7	Setting angle	58
4.8	Power produced by the blade	58
4.9	Number of blades	60
<b>5.1</b>	<b>Chapter Five:-Conclusion and Recommendations</b>	<b>63</b>
<b>6.1</b>	<b>Reference</b>	<b>65</b>

## SYMBOLS

		<b>Units</b>
$A$	Rotor swept area	$m^2$
$A_1$	Area on the upstream side of the rotor	$m^2$
$A_2$	Area on the downstream side of the rotor	$m^2$
$a$	Axial induction factor	
$d$	Tangential induction factor	
$B$	Number of blades	
$D$	Drag force	$N$
$D_p$	Pump piston diameter	$m$
$d_d$	Diameter of the delivery pipe	$m$
$d_p$	Diameter of the pump rod	$m$
$C$	Chord width	$m$
$C_D$	Drag coefficient	

$C_L$	Lift coefficient	
$C_P$	Power coefficient	
$C_T$	Torque coefficient	
$L$	Pump stroke	m
$L_d$	Length of the delivery pipe	m
$L_s$	Span length	m
$F_a$	Axial force	N
$F_d$	Driving force	N
$f$	Friction factor	
$P_a$	Atmospheric pressure	$N/m^2$
$P_x$	Upstream pressure	$N/m^2$
$P_y$	downstream pressure	$N/m^2$
$P_b$	blade power	watt
$V$	Wind speed	$m/sec$
$V_1$	Upstream wind speed	$m/sec$
$V_2$	Downstream wind speed	$m/sec$
$V_r$	Relative speed	$m/sec$
$U$	Speed of the rotor	$m/sec$
$T_b$	Torque on the blade	Nm

## GREEK SYMBOLS

$\alpha$	Angle of attack	degree
$b$	Blade setting angle	degree
$f$	Angle between the relative velocity and the Rotor speed	degree
$\lambda$	Tip speed ratio	
$\lambda_r$	Local tip speed ratio	
$\rho$	Air density	$kg/m^3$
$\rho_s$	Steel mass density	$kg/m^3$
$\omega$	Angular speed of the rotor	$rad/sec$
$\Omega$	Yaw angular speed	$rad/sec$

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